SAN FRANCISCO
WATER DEPARTMENT

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GROUNDWATER MANAGEMENT REPORT

MARCH 1990

PUBLIC UTILITIES COMMISSION

CITY AND COUNTY OF SAN FRANCISCO

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GROUNDWATER MANAGEMENT REPORT

ABSTRACT

In response to the Board of Supervisors' Resolution No. 389-89, San Francisco Water Department staff analyzed three alternatives for increasing the use of groundwater in San Francisco by 3 million gallons per day (mgd). The first alternative (A) would develop on-site wells wherever drinking water is now used for City landscape irrigation plus additional well systems for firefighting usage. This alternative would require 140 wells to produce about 3 mgd of groundwater for non-potable use. The second alternative (B) reduced the number of wells to 87 by incorporating use of the San Francisco Fire Department's auxiliary water supply system to distribute non-potable groundwater. The third alternative (C) considers constructing three or more large capacity wells connected to the City's potable water system feeder mains where groundwater would be mixed with the current water supply. The third alternative would provide the greatest flexibility in meeting emergencies, would offer the best control over groundwater use and would be the least cost alternative. Additional data would be necessary to confirm that groundwater sources meet water quality and quantity requirements. The current proposed 1990-91 budget includes funding to acquire such additional technical information.

Development of non-potable groundwater does not appear to be feasible for more than about 3 mgd. Development of potable groundwater may be feasible above 3 mgd if quantity and quality requirements are confirmed and if slightly harder water would be acceptable.

1. INTRODUCTION

Following two droughts within a 12 year period which required system-wide reduction of water usage by 25%, considerable attention is being given statewide to alternative water sources such as groundwater, reclaimed wastewater and other reuse of water for non-potable uses. This planning level report addresses groundwater as a potential supplementary source which would lessen the impacts of future droughts on San Francisco and provide a standby source of water for emergency conditions.

Groundwater is rain water which has percolated into sand and gravel aquifers beneath the earth's surface and which may be drawn from wells and springs. Groundwater in shallow aquifers is often contaminated by pollutants which seep into the soil from the land surface. Water in deep aquifers is usually free of contaminants but may contain higher dissolved mineral levels when compared to typical surface waters.

The San Francisco Water Department (SFWD) provides water to over 2 million people, approaching an average daily consumption of 290 million gallons (non-drought year), of which the City and County of San Francisco uses 97 million gallons per day (mgd). SFWD delivers over 60 percent of its water supply to 30 suburban cities and water districts (Attachment 1). SFWD's supply is entirely from surface water sources at Hetch Hetchy and in Alameda, Santa Clara and San Mateo counties. Some of the suburban agencies served by SFWD obtain a portion of their water supply needs from groundwater. In the City, groundwater is used principally for irrigation purposes.

2. OBJECTIVES

By Board of Supervisors Resolution No. 389-89, (Attachment 5) as approved by the Mayor May 31, 1989, the PUC was urged to direct the San Francisco Water Department (SFWD) to prepare a groundwater use plan focusing on non-potable use for the area within the City and County of San Francisco.

The resolution requested plans for achieving the following goals:

- o Increase the use of groundwater by 3 million gallons per day (MGD) in 1991
- o Increase the use of groundwater by 8 MGD by 1993

In addition, the Department was asked to determine the funds needed to implement a groundwater plan. The resolution also addressed exploring increased groundwater use for industrial, institutional, firefighting applications and emergency purposes; and in conjunction with the City's Clean Water Program, development of waste water reclamation.

3. BACKGROUND

a) Historical Groundwater Supply of San Francisco County

A Department of Public Works (DPW) report dated May 1913 surveyed approximately 700 wells in San Francisco, concluding that approximately 8.5 MGD of groundwater was being pumped at that time. The study also determined a potential for an additional 3.8 MGD, predominantly from the Sunset and Richmond districts. The report noted that 508 of the wells surveyed were in actual use; the remainder being dry, abandoned, or used for water table observation only. Many of the active wells were shallow and it is doubtful that the quality of water drawn from them would meet today's drinking water standards.

Currently there are 39 known active public and privately owned wells in San Francisco that are being used predominantly for park irrigation, laundry, zoo, emergency and flushing applications. The City owned wells are inspected by the San Francisco Health Department (SFPH) and SFWD for backflow prevention and non-potable water quality testing. Park irrigation and the zoo produce approximately 2 MGD. None of these wells is connected to SFWD's distribution system. Some of the active wells do not produce water meeting potable or drinking water standards particularly in terms of nitrates and coliform bacteria and can only be used for non-potable uses such as landscape irrigation.

The source of a portion of the Presidio's potable water supply is a groundwater system located in the vicinity of Lobos Creek. On occasion, higher nitrate levels are experienced which are corrected by blending with SFWD water. SFWD provides continuous water to the hospitals located on the facility.

b) Current Work in Progress

In 1988, SFWD entered into a jointly funded project with the United States Geological Survey (USGS) to perform a comprehensive study of groundwater resources in San Francisco. Results are to be provided as work phases are completed through October 1991 with a complete report due in May 1992. The objectives of the study are to define aquifer boundaries, storage volumes, safe yields, water quality, and potential for groundwater development in San Francisco, including identification of favorable well installation locations. Final conclusions of the USGS study are not available for inclusion into this Groundwater Report; nevertheless, information gathered to date has been used in preparing this report. The schedule for the USGS study is shown on Attachment 2.

The topography of the City is characterized by high central hills which consist of shallow bedrock, not able to support substantial well development. The major groundwater aquifers are expected to be found in the lower elevations along the periphery of the City. Preliminary USGS information identifies the largest groundwater aquifer in the south west portion of the City extending from the vicinity of Lake Merced into San Mateo County. USGS noted that this groundwater basin is the source of supply for wells in Daly City, South San Francisco and San Bruno. Pumping from wells in the basin may contribute to lowering of the level in Lake Merced. (Attachment 8).

The basin appears to extend from San Francisco International Airport through northern San Mateo County and western San Francisco and to be deepest in the vicinity of Ocean Beach. Groundwater in the basin

apparently is flowing continuously out to sea. Pumping does not appear to be causing salt water intrusion although water levels near active wells have been drawn down below sea level.

Initial water quality testing by USGS indicates that approximately half of the test sites show nitrate levels slightly above acceptable drinking water standards. Nitrate levels are less prevalent or non-existent in the deeper wells predominately located on the westerly side of the City. The source of the nitrates is not clear at this time. Further testing by the USGS for nitrogen isotopes will help identify the presence of sewage, fertilizers, buried organic material or atmospheric deposition, and the relative contribution of each.

c) Potential Market

Part of the data being utilized from the USGS study is a preliminary list of 67 irrigation sites (Attachment 3 and 4) which now use City water for landscape irrigation. The list may not represent all potential sites in the City and some sites may ultimately be eliminated during a future more detailed examination. The sites vary from 3 acres at various playgrounds to the 200 acres in Golden Gate park now using City water. Ownership of the sites includes Federal, State, City, and private agencies. Four of these sites are located in shallow bedrock areas unsuitable for well installation and were eliminated as potential sites for use of groundwater. The remaining 63 irrigation sites represent a potential groundwater market of 738 million gal./yr. or about 2 MGD.

Firefighting needs for emergency or backup water supplies is also a conceivable use of groundwater. In addition to the SFWD water distribution system, the San Francisco Fire Department (SFFD) maintains a separate high pressure pipe distribution system, the Auxiliary Water Supply System (AWSS). This totally separate system is fed from dedicated high elevation reservoirs supplied from the SFWD system. A portion of the AWSS can also be charged with sea water pumped from San Francisco Bay. About half of the City is within the current boundary of this separate system (Attachment 3). Approximately 95 million gallons per year or 0.3 mgd of SFWD water is used in the AWSS.

An additional level of firefighting water supply is located beneath City streets in 151 cisterns also maintained by SFFD. The SFFD is currently expanding both the AWSS and cistern systems through bond funded improvement programs.

A well system located on 43rd and 44th Avenues in the Sunset District, shut-down by SFWD in 1935, was recently transferred to the SFFD for incorporation into the AWSS as an emergency supply.

This report addresses the above identified groundwater market of 2.3 mgd (2 mgd for irrigation and 0.3 mgd for firefighting) as the basis of the requested 3.0 mgd development by 1991. Other potential uses of groundwater by San Francisco industries are yet to be identified. Usage of up to 8 mgd by 1993 for non-potable use will require a further market investigation though this does not appear to be a reachable goal.

d) Groundwater Development

Groundwater is developed by constructing wells. Well construction includes drilling 8" to 20" diameter holes several hundred feet deep into water bearing strata, installing a pipe casing within each hole,conducting tests to confirm expected yield and water quality, installing submersible pumps and motors, inlet screens, connecting piping, and electrical power connections. Additional construction at each well may also include a storage tank, pump house, fencing and other security measures.

Well installation in San Francisco requires a permit issued by the San Francisco Department of Public Health and review by the Departments of Public Works and City Planning. Section 659 of the Public Health Code further directs that construction shall conform to the water well standards of the State of California Department of Water Resources Bulletin 74-81 of December 1981 as modified November 1, 1989. Wells constructed for drinking water use require a permit from the California Department of Health Services and must be sealed to a depth of 150 feet or more, to prevent pollution from surface drainage and require disinfection.

Delivery of the groundwater depends on the proximity of the well to the point of application. For example, additional pipeline may be required to reach or link into existing irrigation systems.

An alternative evaluated in this study includes tapping into the AWSS system to supply groundwater to potential irrigation sites. Wells would be constructed to pump groundwater into the AWSS pipelines or reservoirs to provide for both the firefighting and irrigation needs.

Requirements for maintaining the current level of AWSS readiness for emergencies while also supplying water for irrigation would have to be adequately addressed. The San Francisco Fire Code would require amendments to allow the AWSS to be used for "non-firefighting" purposes such as irrigation. Subsection (b) of Section 10.202.1 states that "any use of water from such hydrants for other than Fire Department purposes is prohibited." The Fire Commission can review and recommend AWSS modifications to the Board of Supervisors every three years or the Board of Supervisors can amend the code at any time.

4. ONGOING STUDIES AND PROGRAMS

Several studies and programs are in progress that relate to and will affect decisions on the use of groundwater. These are described below and, where applicable, listed on Attachment 2 which shows the various schedules for completion.

a) Service Area Alternative Water Supply Study

Subsequent to Resolution 389-89, Board of Supervisors Resolution No. 740-89 (Attachment 6) was passed September 28, 1989 which requested an 18-month "investigation of the potential for conservation, reclamation and groundwater usage to provide reliable water supplies to augment the Hetch Hetchy and local water supplies..." The basis for the report is to be a series of public hearings throughout the SFWD service area, held jointly by SFWD and the 30 agencies that purchase water from SFWD on a wholesale basis.

b) Expanded USGS Study

The USGS is currently developing a proposal for expanding their groundwater study to the SFWD service area within Alameda, Santa Clara and San Mateo Counties. This study would take 4 to 6 years to complete and would provide a firm, scientific basis for continued development of comprehensive groundwater management plans to maximize groundwater use and to explore benefits of groundwater recharge with Hetch Hetchy and local waters available to the service area, and to prevent salt water intrusion, groundwater contamination, and land subsidence.

c) Reclaimed Water Study

Reclaimed water, the reuse of effluent from the City's wastewater treatment plants, is currently being addressed by the Department of Public Works (DPW) and SFWD. A Request For Proposals has been prepared for selection of a consultant to conduct a reclamation and conjunctive use study scheduled for completion in late 1991. The study will include technical and economic evaluation for uses such as irrigation and groundwater recharge, relative to various levels of treatment. Because groundwater and reclaimed wastewater potentially compete for the same markets, the conclusions of this study may be modified by the results of the reclaimed wastewater studies.

d) Water Conservation

Though not directly related to the groundwater Resolution, it should be pointed out that the San Francisco Water Department maintains a comprehensive long-range water conservation program directed to both the City and Suburban customers.

The program includes:

- o Water education materials distributed in the schools.
- o A City landscape ordinance for new construction to improve design and water use efficiency.
- o Public information materials for various types of water users (residential, commercial, industrial, and irrigation).
- o Leak detection and landscape water audit services.
- o Retrofit of older high water using plumbing devices with low flow fixtures.
- o General promotion of water conservation with displays, promotional events and demonstrations.

The SFWD hosted the Northern California Xeriscape Conference on February 5, 1990 which addressed water conservation technology relative to landscaping and irrigation.

e) Additional Programs/Organizations

The SFWD also provides an active role in other regional and statewide programs addressing water resources.

- o Bay Delta Hearings: The State Water Resources Control Board is to review and define water quality requirements to provide reasonable protection of the Bay and Delta waters. In order to achieve the results, the Board could recommend modification to allocations of water to owners of established water rights. To augment and conserve existing water supplies, water users, including San Francisco, are reviewing water conservation measures including alternate sources such as reclaimed water, conjunctive uses and groundwater.

- o Urban Water Management Plan: Amendments to the State Water Code required urban water suppliers to prepare a report addressing alternative water conservation measures which would improve efficiency of water use through evaluation of costs,

environmental and other significant impacts. SFWD completed the initial report December 1985 and must update the report by December 1990. In addition to the previously described conservation program, the report emphasized the reuse of wastewater for extended irrigation purposes.

5. GROUNDWATER DEVELOPMENT ALTERNATIVES

General

Three alternatives were identified for developing groundwater in San Francisco. Two relate to non-potable use while the third is directed to potable use. Alternate A calls for constructing separate wells at sites where non-potable groundwater could be used in place of potable SFWD water. Alternate B calls for construction of wells and use of the SFFD's auxiliary water supply system where possible, to distribute non-potable groundwater to sites currently using potable SFWD water. Alternate C consists of constructing deep potable water wells connected to the City's water distribution system.

Alternates A and B include furnishing groundwater to all feasible sites identified as using SFWD water for irrigation and to the Auxiliary Water Supply System for firefighting. Feasible sites are considered to be those within 1,000 feet of a potential well site or AWSS main. Given the additional cost and disruption due to pipe construction in City streets, sites farther than 1,000 feet from an alternative source were considered uneconomical and best left on the potable SFWD water system.

As earlier described, of a total of 67 sites currently irrigated with SFWD water, only four were eliminated due to the lack of an alternative water source within 1,000 feet. Three sites are not serviceable by well systems under Alternative A but are reachable via the AWSS in Alternative B. The depth to bedrock of nineteen sites is 100 feet or less indicating a marginal groundwater yield, in some cases requiring multiple smaller wells.

For firefighting purposes, pumping groundwater to the SFFD's Twin Peaks Reservoir was selected. As an option, well systems could pump groundwater directly into the AWSS pipelines. Further study could establish the SFFD's cistern system as a viable distribution point for some groundwater and firefighting use.

Cost estimates were prepared for systems to supply the identified irrigation potential of 2.0 mgd based on the list of sites provided by USGS (Attachment 4) and adding 0.3 mgd for firefighting to provide a total of 2.3 mgd. The Board Resolution requested a plan for developing 3.0 mgd by 1991. Using the engineering and cost data derived from the 2.3 mgd analysis, the report was proportionately increased to 3 mgd. This assumes additional sites are available for an additional 0.7 mgd of groundwater to be used for irrigation or by industrial users which are not yet identified. Therefore, the alternatives and costs compare the utilization of 3 mgd.

Capital and Operations and Maintenance costs are noted within the description of each alternative and shown on Table 1. The present worth costs are summarized on Table 2.

Alternative A - Non-Potable Well Systems

This alternate calls for constructing separate wells as close as possible to sites now using SFWD water for irrigation. Large sites will require more than a single well. The shape or configuration of a site can also warrant additional wells; for example, the Sunset Blvd. landscaping is somewhat narrow but 2-1/2 miles in length. Additional circumstances requiring multiple wells are the shallow bedrock areas where the irrigation demand cannot be met from a single facility. Therefore, 141 wells would be required to provide 3 mgd for irrigation at a capital cost of $13,400,000.

Firefighting resources could be augmented by constructing well systems discharging groundwater into the high elevation AWSS reservoirs. For estimating purposes, a separate groundwater water supply for firefighting is proposed consisting of a 1 mgd well system at Lake Honda and a 6,000 feet pipeline discharging into the AWSS Twin Peaks Reservoir near Palo Alto Ave.,

at a capital cost of $1,000,000. The SFFD has viewed Lake Honda as a potential source of supply for the Twin Peaks Reservoir. Additional study could also consider discharging groundwater to the Ashbury AWSS storage tank (Clayton and Carmel).

The estimated total capital cost of Alternate A is $15,400,000 and the annual operations and maintenance costs are $700,000.

Advantages of Alternate A

- Potable water would be saved on a gallon for gallon basis up to approximately 3 mgd.
- Portions could be accomplished quickly through multi-agency cooperation.
- Reliability of the AWSS firefighting system would be enhanced by providing an additional water source.

Disadvantages of Alternate A

- Has highest capital cost of over $15 million.
- Many of the irrigation well pumps would be too small for firefighting demands.
- Non-potable water could not be used for emergency drinking water.
- Groundwater development, management and operations and maintenance would be shared by multiple parties.
- Non-potable groundwater development would compete with potential reclaimed water usage.

Alternative B - Non-Potable Wells and the SFFD Distribution System

This alternate calls for fewer wells and less new pipe by using the SFFD distribution system to transport non-potable water to the irrigation sites.

The San Francisco Fire Department's Auxiliary Water Supply System (AWSS) encompassing half the City (Attachment 3) has the potential to distribute well water to many irrigation sites. If available, the AWSS could accommodate nearly half of the irrigation sites and 0.9 mgd of the 2 mgd identified market for irrigation water. The remaining sites, outside this boundary, would be

served by individual wells as described in Alternative A. As noted, this data was expanded to 3 mgd which is represented in the cost estimates. Maintaining the readiness of the AWSS will require precautionary elements such as automatic shut-off valves for irrigation service connections so that the system has full emergency capability during fires. The capital cost is estimated to be $9,600,000.

The groundwater source for both the firefighting and irrigation service would be a well system pumping groundwater to the Twin Peaks Reservoir into the AWSS mains, similar to Alternative A. ($1,000,000).

The total capital cost is $10,600,000 and the annual operations and maintenance is $500,000.

Advantages of Alternate B

- Potable water would be saved up to 3 mgd.
- Has a lower cost than Alternative A.
- Reliability of AWSS source of supply would be improved.
- Groundwater would be available for firefighting in emergency situations.

Disadvantages of Alternate B

- High capital cost (over $10 million).
- Imposes additional management burden on SFWD to supply irrigation customers.
- Non-potable water could not be used for emergency drinking water without additional treatment.
- Non-potable groundwater development would compete with potential reclaimed water usage.
- Requires change of Fire Code.

Alternative C - Potable Water Source

This alternative calls for constructing a few deep wells to pump potable groundwater into SFWD feeder mains where it would be blended with SFWD water

to achieve a dependable, high quality water supply. This would take advantage of the existing SFWD distribution system to distribute groundwater to all parts of the City and to accommodate current firefighting usage without AWSS modifications. Alternate C assumes three 1 mgd wells that would provide 3 mgd of potable quality water without additional treatment except chlorination as required by State Health Department regulations. Wells would be located in the southwest part of the City and would draw from the aquifer currently used by Daly City. Based on initial results of the USGS' testing, an expanded aquifer testing program will be necessary to assure that additional pumping would not overdraft this basin. Additional water quality testing will also be necessary to assure that groundwater meets all drinking water standards.

Alternative C would initially provide 3 mgd of additional water supply to San Francisco. At this level of pumping, hardness of the water delivered would remain under 3 grains per gallon (soft water). It could be expanded to provide 10 mgd or more for short term emergencies or for continuous use if the groundwater basins will sustain this level of pumping. At this level, blended water hardness would be expected to increase to 7 grains per gallon (moderately hard water). Current information indicates that a large volume of fresh water moves through the ground to the ocean, However, there is also evidence that the groundwater basin near Lake Merced may be currently overdrafted by existing wells in north San Mateo County. Additional pumping could lower the level of Lake Merced or cause sea water intrusion into the basin.

Use of groundwater as a drinking water supply is very common outside of San Francisco. In recent years it has been found that groundwater can become contaminated by leaking underground fuel and industrial solvent tanks. Frequent testing and sound environmental management is needed to assure that potable water aquifers are maintained free of such contaminants. The capital cost of Alternate C is $1,700,000 and the annual operations and maintenance is $300,000.

Advantages of Alternate C

- Has the lowest cost of all three alternatives ($1.7 million).
- SFWD would be the single agency in charge of supply and distribution.
- Usage could be expanded beyond 3 mgd.
- Has minimal construction impacts -- uses existing City distribution system.
- Potable groundwater would be available for emergency situations.
- Would not compete with non-potable uses for reclaimed water.

Disadvantages of Alternate C

- Feasibility is contingent on adequate groundwater basin yield.
- Requires public acceptance of groundwater blended with Hetch Hetchy and local reservoir water.
- Increased pumping could cause further lowering of Lake Merced and the potential of salt water intrusion. The safe yield of the basin is uncertain at this time.

TABLE 1

GROUNDWATER ALTERNATIVES
CAPITAL AND OPERATIONS AND MAINTENANCE COSTS
FOR 3.0 MGD

ALTERNATIVE	CAPITAL	ANNUAL O & M
Alternative A		
I. Non-Potable Wells	$ 13,400,000	$ 640,000
II. Firefighting	1,000,000	60,000
TOTAL	$ 14,400,000	$ 700,000/yr.
Alternative B		
I. Non-Potable Wells & AWSS	$ 9,600,000	$ 440,000
II. Firefighting	1,000,000	60,000
TOTAL	$ 10,600,000	$ 500,000/yr.
Alternative C		
"Potable" Groundwater	$ 1,700,000	$ 300,000/yr.

TABLE 2

GROUNDWATER ALTERNATIVES
PRESENT WORTH COSTS
FOR 3.0 MGD

ALTERNATIVE A	I. Install 141 irrigation wells	$22,400,000
	II. Pump groundwater to AWSS Twin Peaks Resv.	1,800,000
TOTAL		$24,200,000
ALTERNATIVE B	I. Combination of 87 wells and 42 taps to the AWSS system:	$15,900,000
	II. Pump G.W. to Twin Peaks	1,800,000
TOTAL		$17,700,000
ALTERNATIVE C	Three potable wells and connections to the "SFWD" distribution system	
TOTAL		$ 5,500,000

NOTE: Assumes 5% interest and a 25-year project life.

6. ANALYSIS OF ALTERNATIVES

Alternative A includes individual non-potable wells at or near each irrigation site. Alternative B, where possible, uses the AWSS system for distribution of non-potable groundwater with the remaining sites serviced by individual wells, similar to Alternative A. Alternative C calls for a few large wells pumping potable groundwater directly into SFWD distribution system.

Alternative A is the highest cost for both capital ($14,400,000), and O&M ($700,000/yr) costs. Alternative B is reduced somewhat by use of the AWSS distribution system, but still remains as a high cost alternate ($10,600,000 capital and $500,000/yr O&M). For reference, the annual cost to deliver 3 mgd of SFWD water at the current rate ($.587 per 100 cubic feet) is $860,000/year. By far the lowest cost alternate is Alternative C ($1,700,000 capital, $300,000 O&M) comprising just a few deep high capacity wells pumping potable groundwater into the existing SFWD distribution system.

Construction impacts would be greater for Alternatives A&B, requiring more construction in City streets, plus disruption of public areas during drilling of the many wells. Alternative C which utilizes the existing water distribution system, would involve much less disruption since fewer locations would be used.

The report assumes the existing aquifers can provide groundwater in the required volumes. The viability of Alternatives A&B depends on aquifers being at or close to the particular user sites. Since the well locations under Alternative C are not oriented to a particular user, the locations of the potable wells are somewhat more flexible. The deep higher-yield aquifers are expected to be found in the southwest portion of the City where many SFWD feeder mains are located.

Water quality is a most sensitive requirement for use of groundwater. Initial well testing by the USGS has shown that, especially in the shallower wells, evidence of nitrates were noted, some exceeding drinking

water standards. Water quality standards are less stringent for irrigation or industrial usage such as the non-potable uses under Alternatives A&B. However, switch-over of existing irrigation systems now using City water would require investigations and may require plumbing modifications to assure that potential cross connections between the potable and non-potable systems are eliminated. Aquifers subject to higher chloride contents will have limited landscaping use due to the salt sensitivity of most plants. For the purpose of this analysis it is assumed that potable water will be available from the deeper aquifers for Alternative C. A high level water quality testing program will be required to supplement the results of the USGS study, to assure that groundwater meets all drinking water standards. Well water in general contains higher levels of minerals than is found in surface waters. Groundwater under Alternative C would be blended with a much larger volume of SFWD surface water, which is very low in mineral content, to prevent any change in the aesthetic quality of the water delivered. Well water is usually free of bacteria, but disinfection by chlorine or ozone may be required under new State regulations.

The deeper wells in Alternative C increase the risk of overdrafting with the potential of land subsidence and salt water intrusion. The USGS and reclaimed water studies will further address these issues. The USGS list highlighted a number of sites that could experience salt water intrusion.

Many of the irrigation sites are owned by non-City agencies which, under Alternatives A&B, would require an equitable means for sharing construction, maintenance, and management costs. The conversion to non-potable water for commercial or industrial use would require the user to install separate facilities for this source. Alternative C which pumps groundwater directly into the SFWD distribution system would not change current water delivery practice. Alternative C assigns the management and maintenance responsibility to a single City agency, SFWD, which would allow continuation of the current metering and billing procedures.

While little if any public opposition would be expected in the non-potable useage of groundwater under Alternatives A&B, acceptance of groundwater into the potable SFWD system (Alternative C) is expected to be a more sensitive matter. Early public involvement would be imperative, including public information and education programs to assure that all water quality issues are understood and addressed.

All of the alternatives will require an environmental review. It is not known at this time what degree of groundwater development would be exempt, sufficed by a Negative Declaration, or require a formal Environmental Impact Report (EIR).

Major issues over and above water quality and quantity that will need to be addressed are:

Large withdrawals from aquifers being used by other jurisdictions such as Daly City, could involve unresolved legal water rights issues. This situation has a greater impact on Alternative C where the preliminary location of the deep larger capacity wells are within the Lake Merced aquifer.

All of the alternatives will require an in-depth review of public health, fire and safety regulations from various regulatory agencies. This is especially significant for Alternative B which would share the AWSS with both irrigation and fire fighting demands.

Well drilling may locate soil or groundwater contamination which could require clean-up activity under State and Federal toxic waste regulations.

Standby power would be considered for the larger high capacity wells especially in Alternative C to assist in firefighting and other emergency situations.

Development of reclaimed water for non-potable use will compete for many of the same uses as groundwater.

research into other users. This would require identification of high water users and individual contacts to access their ability of accepting non-potable water.

Considering the social, political, environmental and engineering question identified in this study, it is not likely that an extensive groundwater program for 3 mgd could be implemented by 1991.

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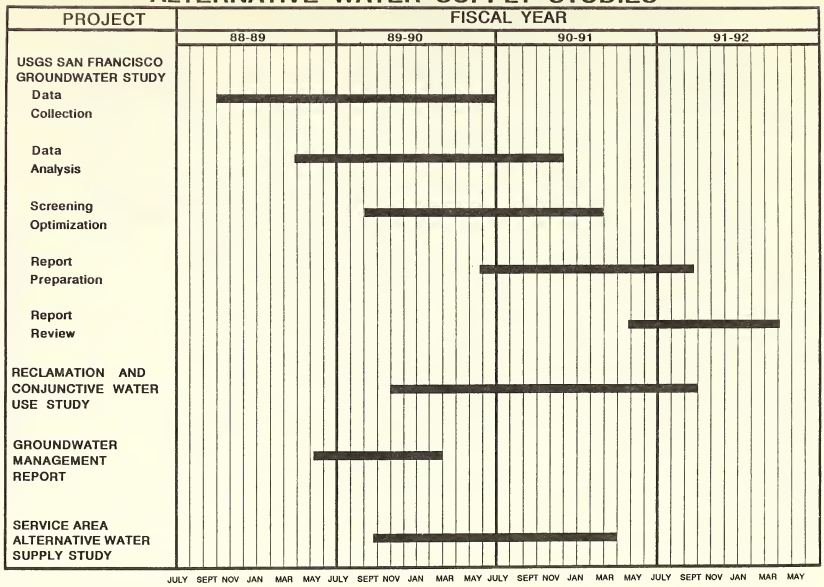
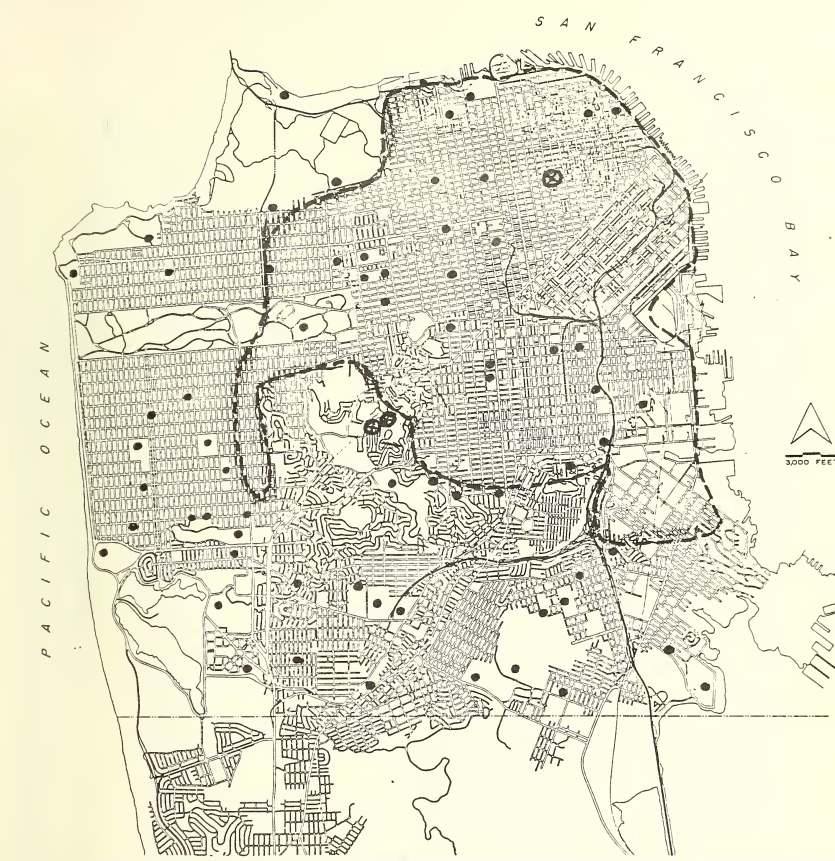
ATTACHMENT 1

ALTERNATIVE WATER SUPPLY STUDIES





LOCATION OF POTENTIAL IRRIGATION SITES AND THE AUXILIARY WATER SUPPLY SYSTEM

- Irrigation Site
- AWSS Service Boundry
- AWSS Reservoir

ATTACHMENT 3

IRRIGATION AND POTENTIAL GROUND-WATER USE AT SELECTED LOCATIONS IN SAN FRANCISCO.

PRELIMINARY DATA PROVIDED BY THE UNITED STATES GEOLOGICAL SURVEY (USGS)

(1)

LOCATION		IRRIGATION				REQ.[4] PUMP. RATE (gpm)	GW BASIN DEPTH (ft)	ACCESS[5] TO AWSS	REMARKS
NAME	STREET INTERSEC.	IRRIG.[1] AREA (ACRES)	ANNUAL[2] (Mgal/ yr)	DAILY[3] (X 1000 gpd) APR.	JULY				
I. AREAS NOW IRRIGATED WITH SAN FRANCISCO WATER DEPARTMENT WATER									
1 *Fort Mason (Fed)	------	32	20	85	140	570	≤50	yes	Bedrock on N side, potential sea-water intrusion, best well site is in SW corner. Irrigated area estimated as 60 percent of total area.
2 *George Moscone Rec. Ctr.	Bay & Laguna	130	8	35	56	230	200	yes	Best well site is in NE corner.
3 Marina Green	Marina Green Dr.	11	7	29	47	200	50-200	no	Potential seawater intrusion, possibly minimized by 15-20 ft. thick layer of bay mud.
4* Lafayette Square	Gough & Clay	12	7	32	51	214	0	yes	Bedrock.
5 Alta Plaza	Pierce & Clay	12	7	32	51	214	≤50	no	Maximum thickness in SE corner. Bedrock in NW corner. Springs reported.
6* Washington Square	Stockton & Union	3	2	8	13	53	0	yes	Bedrock.
7 Embarcadero	Battery & Union	2	1	5	9	36	≤100	yes	Potential seawater intrusion.
Presidio:									
8 1) Kahn Playground (Fed)	------	4	2	11	17	71	≤100	no	Best site on N side. Spring reported.

PRELIMINARY DATA
SUBJECT TO REVISION

ATTACHMENT 4

IRRIGATION AND POTENTIAL GROUND-WATER USE AT SE' TED LOCATIONS IN SAN FRANCISCO.

PRELIMINARY DATA PROVIDED BY THE UNITED STATES GEOLOGICAL SURVEY (USGS)

(2)

LOCATION		IRRIGATION							
NAME	STREET INTERSEC.	IRRIG.[1] AREA (ACRES)	ANNUAL[2] (Mgal/ yr)	DAILY[3] (X 1000 gpd) APR.	JULY	REQ.[4] PUMP. RATE (gpm)	GW BASIN DEPTH (ft)	ACCESS[5] TO AWSS	REMARKS
9. * 2) McDowell & Crissy Field (Fed.)	------	4	2	11	17	71	75	no	Possible service to cemetery & Fort Scott, potential seawater intrusion. City water?
10 Mountain Lake Park	Lake & 11th Ave.	13	8	35	56	232	100	no	Possible negative effect on Mtn. Lake, Lobos Creek, and Presidio golf course wells.
11 Lincoln Park	------	13	81 (2M30	350	560	2300	≤100	no	Bedrock on N and W sides. Best well site in SE corner. Pipeline from GGP? Irrigated area shown estimated as 50 percent of total area.
12 Sutro Park (Fed)	------	23	14	61	98	410	≤50	no	Bedrock on W and S sides. Limited yield. Best well site in center.
13 Park Presidio Blvd ✓	------	33	21	88	141	588	100-200	no	Best well site near or south of Geary.
14 Rossi Playground	Arguello & Anza	6	4	16	26	107	150	no	Any well site ok.
15 * SF College for Women (Private)	Anza & Parker	25	16	67	107	445 Combine	0	no *	Bedrock. Small and scattered irrigated areas.
* University of SF:									
16 1) West playing field (Private)	------	6	4	16	26	107	≤100	yes	Bedrock in SE corner. Best well site at W edge.
17 2) East playing field (Private)	------	3	2	8	13	53	50	no	Best well site in SE corner.
18 * Alamo Square	Steiner & Grove	15	9	40	64	267 Combine	0	yes	Bedrock.
✓9 Jefferson Square	Turk & Gough	15	9	40	64	267	50-150	yes	Best well site on S side.

PRELIMINARY DATA
SUBJECT TO REVISION

IRRIGATION AND POTENTIAL GROUND-WATER USE AT SE TED LOCATIONS IN SAN FRANCISCO

PRELIMINARY DATA PROVIDED BY THE UNITED STATES GEOLOGICAL SURVEY (USGS)

(3)

	LOCATION		IRRIGATION							
	NAME	STREET INTERSEC.	IRRIG.[1] AREA (ACRES)	ANNUAL[2] (Mgal/ yr)	DAILY[3] (X 1000 gpd) APR.	DAILY[3] (X 1000 gpd) JULY	REQ.[4] PUMP. RATE (gpm)	GW BASIN DEPTH (ft)	ACCESS[5] TO AWSS	REMARKS
20	Hamilton Rec./Kimball Playground	Pierce & Post	11	7	29	7	196	240	yes	Good yield potential. Any Well site ok. Near Mt. Zion Hospital well.
21*	~~Washington High School~~	~~Anza & 30th Ave.~~	~~5~~	~~3~~	~~13~~	~~21~~	~~89~~ Combined	~~0~~	~~no~~ *	~~Bedrock.~~
	*Golden Gate Park:									
22	1) MAIN Park	------	200	125	534	855	3562	0-600	yes	Limited yield in NE area near bedrock outcrop. Greatest potential yield between Elk Glen and windmill wells. Best site is in W end near a lake & irr. main. Irrigated area shown is appx. area now irrigated with city water; remainder is already irrigated by wells.
23	*2) Panhandle	------	25	16	67	107	445	≤150	yes	Possible limited yield.
24	Duboce Park	Duboce & Scott	5	3	13	21	89	50-75	no	Best well site at E end. Nearby well at Davies Hospital yields only 5-10 gpm.
25	Mission High School	Dorland & Church	3	2	8	13	53	120	yes	Best well site at E end.
26	Mission Park	Church & 19th St	17	11	45	73	303	≤120	yes	Bedrock in SW corner. Best well site in NE corner.
27*	Franklin Square	16th St & Bryant	5	3	13	21	89 Combined	0	yes	Bedrock.
28	Jackson Playground	17th St & Ark.	6	4	16	26	107	≤40	yes	Best well site in NW corner.
29*	Potrero Hill Rec. Ctr.	Madera & Ark.	11	7	29	47	196	0	no *	Bedrock.

PRELIMINARY DATA
SUBJECT TO REVISION

IRRIGATION AND POTENTIAL GROUND-WATER USE AT SE TED LOCATIONS IN SAN FRANCISCO.

PRELIMINARY DATA PROVIDED BY THE UNITED STATES GEOLOGICAL SURVEY (USGS)

	LOCATION		IRRIGATION							
	NAME	STREET INTERSEC.	IRRIG.[1] AREA (ACRES)	ANNUAL[2] (Mgal/ yr)	DAILY[3] (X 1000 gpd) APR.	DAILY[3] (X 1000 gpd) JULY	REQ.[4] PUMP. RATE (gpm)	GW BASIN DEPTH (ft)	ACCESS[5] TO AWSS	REMARKS
31	*West Sunset Playground	Pacheco & 41st	10	6	27	43	178	125	no	Good location for development of ground water.
32	Athletic Field	Rivera & 38th	4	3	11	17	71	125	no	Good location for development of ground water.
33	Sunset Strip	------	86	54	230	368	1532	≥100	no	Best well site is away from Lake Merced (N of Vicente St.)
34	*Sunset Recreation Center	Lawton & 28th	2	1	5	9	36	75	no	Any well site ok.
35	Sunset Reservoir	Pacheco & 28th	10	6	27	43	178	≤50	no	Possible limited yield.
36	*Lincoln H.S./McCoppin Sq.	Taraval & 23rd	23	14	61	98	410	125	no	Bedrock at N end. Best well site at S end.
37	Laguna Honda Home	Laguna Honda & Woodside	24	15	64	103	427	≤300	yes	Bedrock near N, E, & S sides. Best site in SW corner.
~~38~~	~~*Glen Canyon Park~~	~~------~~	~~16~~	~~10~~	~~43~~	~~68~~	~~285~~ Combine	~~0~~	~~no~~	~~Bedrock.~~
~~39~~	~~*George Christopher Plygd~~	~~Diamond Hts/ Duncan~~	~~4~~	~~3~~	~~11~~	~~17~~	~~71~~ Combine	~~0~~	~~no~~	~~Bedrock.~~
~~40~~	~~*Walter Haas Plygd~~	~~Diamond Hts/ Duncan~~	~~5~~	~~3~~	~~13~~	~~21~~	~~89~~ Combine	~~0~~	~~no~~	~~Bedrock.~~
41	Upper Noe Rec. Ctr.	Day & Sanchez	3	2	8	13	53	≤25	no	Bedrock except NE corner. Limited yield.
42	Precita Park	Folsom & Precita	5	3	13	21	89	50	no	Possible limited yield. Uniform site potential.
43	Rolph Playground	Potrero & Army	3	2	8	13	53	25-50	yes	Bedrock near S side. Possible limited yield.

PRELIMINARY DATA
SUBJECT TO REVISION

IRRIGATION AND POTENTIAL GROUND-WATER USE AT SELECTED LOCATIONS IN SAN FRANCISCO.

PRELIMINARY DATA PROVIDED BY THE UNITED STATES GEOLOGICAL SURVEY (USGS)

(5)

	LOCATION		IRRIGATION						
					DAILY[3] (X 1000 gpd)		REQ.[4] PUMP.	GW BASIN	ACCESS[5] TO
NAME	STREET INTERSEC.	IRRIG.[1] AREA (ACRES)	ANNUAL[2] (Mgal/yr)	APR.	JULY	RATE (gpm)	DEPTH (ft)	AWSS	REMARKS
44 Fleishhacker Zoo	------	94	59	251	402	1674	>300	no	Most irrigation now supplied by wells. Additional pumpage may impact Lake Merced.
45 Ulloa School	Wawona & 40th	3	2	8	13	53	>200	no	May have small negative effect on Lake Merced.
46 Stern Grove	------	30	19	80	128	534	>300	no	Existing well supplies some water. Pumpage at unused SF CWP well may slightly impact Lake Merced. Irrigated area shown is appx. area now irrigated with city water.
47 Parkside Square	Vicente & 26th	3	2	8	13	53	150-200	no	
48 Edgewood School	Vicente & 29th	1	1	3	4	18	150-200	no	Idle well, no pump; interest in using for irrigation.
49 Larsen Park	Vicente & 19th	19	12	51	81	338	≤150	yes	Bedrock near middle of E side. Best site at N end.
50 Reservoir	Sloat & 23rd	4	3	11	17	71	200	no	Pumpage may have an adverse impact on Lake Merced.
51 SF State University (State)	------	20	13	53	86	356	≤300	no	Bedrock at 19th Ave. Increased pumpage would have a negative impact on Lake Merced.
52 Juan Batista Circle	Font & Crespi	15	9	40	64	267	100-300	no	Increased pumpage would adversely effect Lake Merced.
53 Aptos Playground	Ocean & Aptos	5	3	13	21	89	≤30	no	Bedrock in E half. Possible limited yield &

PRELIMINARY DATA
SUBJECT TO REVISION

IRRIGATION AND POTENTIAL GROUND-WATER USE AT SELECTED LOCATIONS IN SAN FRANCISCO.

PRELIMINARY DATA PROVIDED BY THE UNITED STATES GEOLOGICAL SURVEY (USGS)

(6)

LOCATION		IRRIGATION							
NAME	STREET INTERSEC.	IRRIG.[1] AREA (ACRES)	ANNUAL[2] (Mgal/ yr)	DAILY[3] (X 1000 gpd) APR.	DAILY[3] (X 1000 gpd) JULY	REQ.[4] PUMP. RATE (gpm)	GW BASIN DEPTH (ft)	ACCESS TO AWSS	REMARKS
									negative impact on Lake Merced.
54 Riordan H.S. (Private)	Phelan & Judson	4	2	11	17	71	80	no	Pumpage may have a small negative impact on Lake Merced.
55* City College of SF	------	21	13	56	90	374 Combine	0	no *	Bedrock.
56 Balboa Park	Ocean & San Jose Ave.	26	16	69	111	463	≤100	no	Pumpage may have a small negative effect on Lake Merced.
57 Chalmer's Playground	Brunswick & Roener	1	1	3	4	18	≤150	no	Any well site ok.
58 Ocean View Rec. Ctr.	Plymouth & Lobos	9	6	24	38	160	≤50	no	Bedrock on N side. Possible small negative effect on Lake Merced.
59 Crocker Amazon Playground	Geneva & Moscow	29	18	77	124	517	≤50	no	Bedrock on E, S, and NW sides. Potential limited yield.
60 *Gleneagles Golf Course	Sunnydale Ave.	43	27	115	184	766	≤100	no	Bedrock on N, W, and SW sides. Potential limited yield. Irrigated area shown estimated as 69 percent of total area.
61 Good Shepherd Convent (Private)	Wayland & Oxford	12	7	32	51	214	≤100	no	Bedrock on west half. Potential limited yield.
62 Louis Sutter Playground	Wayland & Univ.	7	4	19	30	125	≤50	no	Bedrock on N and SW sides. Best site on E side.
63 Portola Rec. Ctr.	Felton & Somerset	4	2	11	17	71	≤100	no	Best site is in SE area.
64 Silver Terrace Plygd.	Silver & Ledyard	4	2	11	17	71	≤100	no	Best site is on S side.

PRELIMINARY DATA
SUBJECT TO REVISION

IRRIGATION AND POTENTIAL GROUND-WATER USE AT SEL ED LOCATIONS IN SAN FRANCISCO.

PRELIMINARY DATA PROVIDED BY THE UNITED STATES GEOLOGICAL SURVEY (USGS)

(7)

LOCATION		IRRIGATION							
NAME	STREET INTERSEC.	IRRIG.[1] AREA (ACRES)	ANNUAL[2] (Mgal/ yr)	DAILY[3] (X 1000 gpd) APR.	DAILY[3] (X 1000 gpd) JULY	REQ.[4] PUMP. RATE (gpm)	GW BASIN DEPTH (ft)	ACCESS[5] TO AWSS	REMARKS
65 Visitacion Valley Plygd.	Leland & Cora	3	2	8	13	53	≤20	no	Bedrock at NW corner. Potential limited yield.
66 Bret Harte School	Gilman & Hawes	5	3	13	21	89	≤60	no	Bedrock on N, W, & S sides. Potential intrusion & limited yield.
67* Candlestick Park	------	2	1	5	9	36 Combine	0	no ✗	Bedrock.
TOTAL I		1,213	757 .2 mgd	3,240	5,193	21,588			
II. AREAS NOW IRRIGATED WITH GROUND WATER									
Great Highway	------	34	21	91	145	606	300	no	Best well site is away from Lake Merced (N of Vicente St.). Presently irrigated by Zoo wells.
Harding Park	Lake Merced	100	62	267	428	1,781	≥250	no	Golf course now irrigated with water pumped from Lake Merced. Existing idle well has pump. Use of well may have a small beneficial effect on Lake Merced. Irrigated area shown was estimated as 69 percent of total area.
TOTAL II		134	84 .23 mgd	358	573	2,387			

PRELIMINARY DATA SUBJECT TO REVISION

*Wells at these locations would be especially useful for meeting the information needs of the cooperative water resources and geohydrologic study.

1. Locations are assumed to be 100 percent irrigated unless otherwise noted under "Remarks".

2. Equals sum of monthly reference evapotranspiration for April through September of a normal climatic year from DWR Bulletin 113-

3. Daily water use in July of normal climatic year. (0.157 inches per day).

4. Assumes one-quarter of the area is irrigated each day on a 4-day rotation and that sprinklers operate 4 hours per day.

5. "Yes" indicates that pipeline of the Auxilliary Water Supply System used for fire fighting is located beneath one or more streets adjacent to the irrigated location.

FILE NO. 177-89-2

RESOLUTION NO. 389-89

[GROUND WATER MANAGEMENT AND UTILIZATION]

RESOLUTION TO URGE THE MAYOR TO URGE THE SAN FRANCISCO PUBLIC UTILITIES COMMISSION TO DIRECT THE WATER DEPARTMENT TO IMPLEMENT A PROGRAM TO IMPROVE GROUND WATER MANAGEMENT AND UTILIZATION IN SAN FRANCISCO.

WHEREAS, The City of San Francisco obtains 80-90% of its daily water usage from over 200 miles away, and

WHEREAS, The Hetch-Hetchy system and the local watershed supply water to 2.2 million people in five counties with a maximum delivery of approximately 325 million gallons/day, and

WHEREAS, The average annual demand may reach 325 million gallons/day by the year 2005, and

WHEREAS, The increased utilization of local ground water for irrigation, industrial applications and emergency supply would reduce our dependancy on the Hetch-Hetchy system, and increase our capacity for conservation, and

WHEREAS, San Francisco should take every reasonable measure to ensure a reliable supply of water to its 741,000 residents and businesses in the event of an emergency or major earthquake, and

WHEREAS, In 1913 the City Engineer M.M. O'Shaughnessy conducted a detailed ground water survey, indicating 8.5 million gallons/day groundwater being drawn by approximately 700 wells, with an estimated additional utilization capacity for 3.8 million gallons/day, and

WHEREAS, At least five other recent geologic studies since 1970, conducted by professional engineering firms indicated the potential for substantial ground water development within San Francisco, and

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WHEREAS, In 1988 the Geological Survey, U.S. Department of the Interior entered into a contract with the S.F. Water Department to describe the nature and availability of ground water in the San Francisco region and determine its potential for development based on hydrogeologic and water quality constraints, and

WHEREAS, the final report on this study will not be complete until 1992, and

WHEREAS, The San Francisco Water Department was forced to impose a temporary systemwide 25% water rationing program in response to the recent drought, and requiring city-wide water use reductions of 15%, and

WHEREAS, The December 1988 California Water Guidelines, prepared jointly by the County Supervisors Association of California and The League of California Cities states that "local entities responsible for developing and implementing ground water basin management plans should be supported," now, therefore be it

RESOLVED, That it is imperative to take action now to protect ground water quality, expand irrigation uses, indentify appropriate industrial purposes for nonpotable water, increase water reclamation and reuse, review options for developing our emergency water supply and continue to study the decrease of the water level in Lake Merced, and be it

FURTHER RESOLVED, That the Mayor urge the Public Utilities Commission to direct the Water Department to provide within 180 days to the Board of Supervisors their ground water management and utilization plan, to include:

1. The utilization of local ground water resources over a three year period commencing from the current levels with a 3 million gallon/day increase in 1991, and reaching an increased utilization goal of approximately 8 million gallons/day of ground water for

nonpotable purposes by 1993.

a. The fiscal provisions to reach this goal to be included as a priority in the Operating Budget of the 1990-1991 Water Department.

2. To explore options for increased utilization of ground water for industrial, institution and fire fighting purposes.

3. To further develop plans utilizing ground water to its maximum potential for emergency purposes in the event of a major disaster or earthquake.

4. To further develop conservation plans within the Department of Public Works and the Water Department to improve wastewater reclamation and reuse, and be it

FURTHER RESOLVED, That copies of this resolution be transmitted to the Mayor, with the request that all necessary action be taken to ensure its legislative intent.

Adopted - Board of Supervisors, San Francisco May 22, 1989

Ayes: Supervisors Alioto Britt Gonzalez Hallinan Hsieh Maher
Nelder Walker Ward

Absent: Supervisors Hongisto Kennedy

I hereby certify that the foregoing resolution was adopted by the Board of Supervisors of the City and County of San Francisco

Clerk

File No. 177-89-2

MAY 31 1989
Date Approved

Mayor

As amended in Board
9/25/89

FILE NO. 177-89-3.1

RESOLUTION NO. 740-89

[Water Supply Studies]

URGING THE MAYOR TO URGE THE PUBLIC UTILITIES COMMISSION TO INVESTIGATE, HOLD HEARINGS, DEVELOP PROGRAMS AND REPORT ITS FINDINGS TO THE BOARD OF SUPERVISORS WITHIN EIGHTEEN MONTHS ON THE POTENTIAL FOR CONSERVATION, RECLAMATION AND GROUNDWATER USE WITHIN THE WATER DEPARTMENT'S SERVICE AREA.

WHEREAS, The City and County of San Francisco ("City") through its Public Utilities Commission ("Commission") owns and operates a water supply system which provides domestic, municipal and industrial water to more than two million Bay Area residents; and

WHEREAS, To better husband the water currently supplied from the Hetch Hetchy and local watersheds, programs should be instituted for conservation, reclamation of waste water and use of groundwater supplies; and

WHEREAS, To the extent it is environmentally sound, economically reasonable, and consistent with social and public policies, reliable water supplies produced by conservation, reclamation and groundwater programs should be used to augment the high quality water produced by the San Francisco watersheds; and

WHEREAS, The Commission currently does not have information on the feasibility of augmenting its water supplies through the use of conservation, reclamation and groundwater; and

WHEREAS, Resolution 389-89, approved on May 31, 1989, called for the Water Department to conduct a study on how to improve groundwater management and utilization and how to further develop conservation plans and wastewater reclamation and reuse within the City and County of San Francisco, and that report will be provided to the Board of Supervisors in November, 1989; now, therefore, be it

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RESOLVED, That the Board of Supervisors urges the Mayor to urge the Public Utilities Commission to begin an investigation of the potential for conservation, reclamation and groundwater usage to provide reliable water supplies to augment the Hetch Hetchy and local water supplies, as further resolved herein; and be it

FURTHER RESOLVED, That the Commission, in cooperation with its suburban water customers, shall hold a series of public hearings throughout the Water Department service area to receive information on conservation, reclamation and groundwater practices which will better husband the City's water supplies; and be it

FURTHER RESOLVED, That the Commission shall undertake cooperative efforts with its suburban water customers to develop programs for conservation, reclamation and groundwater usage; and be it

FURTHER RESOLVED, That within 18 months from the enactment of this resolution the Commission shall report to the Board of Supervisors of its findings regarding the use of conservation, reclamation and groundwater supplies which, consistent with environmental and economic considerations and social and public policies, will produce reliable sources of water that will better husband the City's Hetch Hetchy and local water supplies; and be it

FURTHER RESOLVED, That this report shall incorporate the findings and recommendations of the report on groundwater management and utilization, conservation, and wastewater reclamation and reuse that shall be submitted to the Board of Supervisors in November, 1989.

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Supervisor Maher

Page No. 2

0383a

BOARD OF SUPERVISORS

136

9/25/89 1d

ATTACHMENT 6

Adopted - Board of Supervisors, San Francisco September 25, 1989

Ayes: Supervisors Alioto Britt Gonzalez Hallinan Hsieh Maher
Nelder

Absent: Supervisors Hongisto Kennedy Walker Ward

I hereby certify that the foregoing resolution
was adopted by the Board of Supervisors
of the City and County of San Francisco

Clerk

File No.
177-89-3.1

9/28/89
Date Approved

Mayor

CAPITAL COST SUMMARY

WELLS & AWSS

CONNECTIONS

SITE NO.	ACRES	ANNUAL MILLION GALLONS	ALTERNATIVE A WELLS	ALTERNATIVE B WELLS & AWSS*
1	32	20	$237,500	$52,500*
2	130	8	127,000	38,600*
3	11	7	110,000	61,300*
4	12	7	combine with #5	33,900*
5	12	7	includes #5 257,000	48,800*
6	3	2	combine with # 7	34,300*
7	2	1	include #6 130,500	31,100*
8	4	2	54,000	54,000
9	4	2	50,000	50,000
10	13	8	84,000	68,100*
11	13	81	715,500	715,500
12	23	14	198,000	198,000
13	33	21	264,000	264,000
14	6	4	69,500	33,700*
15	25	16	combine with #16	47,300*
16	6	4	includes #15 227,000	37,800*
17	3	2	40,000	40,000
18	15	9	--	35,600*
19	15	9	107,500	37,500*
20	11	7	106,000	35,600*

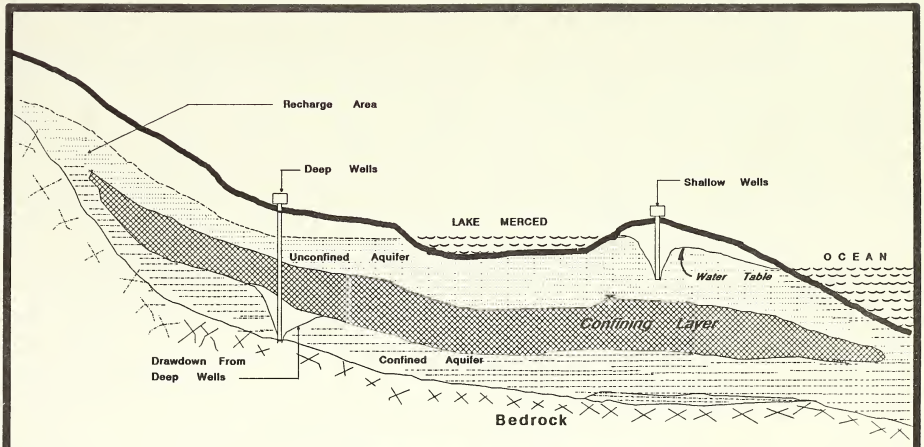
* Site connected to AWSS

ATTACHMENT 7

SITE NO.	ACRES	ANNUAL MILLION GALLONS	ALTERNATIVE A WELLS	ALTERNATIVE B WELLS & AWSS*
21	5	3	--	--
22	200	125	2,105,000	102,000*
23	25	16	210,000	133,500*
24	5	3	52,000	52,000
25	3	2	60,000	35,400*
26	17	11	100,000	36,000*
27	5	3	--	34,100*
28	6	4	include #30 154,500	35,400*
29	11	7	--	89,300*
30	4	3	combine with #28	48,500*
31	10	6	79,000	79,000
32	4	3	60,000	60,000
33	86	54	510,000	510,000
34	2	1	44,000	44,000
35	10	6	102,000	90,300*
36	23	14	132,000	71,300*
37	24	15	228,000	99,600*
38	16	10		--
39	4	3		--
40	5	3		--
41	3	2	36,000	36,000
42	5	3	49,000	49,000
43	3	2	43,000	37,100*
44	94	59	807,000	807,000

* Site connected to AWSS

SITE NO.	ACRES	ANNUAL MILLION GALLONS	ALTERNATIVE A WELLS	ALTERNATIVE B WELLS & AWSS*
45	3	2	72,000	72,000
46	30	19	240,000	240,000
47	3	2	72,000	72,000
48	1	1	51,000	51,000
49	19	12	108,000	46,500*
50	4	3	94,000	94,000
51	20	13	225,000	225,000
52	15	9	183,000	183,000
53	5	3	39,500	39,500
54	4	2	include #55 287,000	287,000
55	21	13	combined with #54	--
56	26	16	156,000	156,000
57	1	1	52,000	52,000
58	9	6	86,000	86,000
59	29	18	198,000	198,000
60	43	27	262,000	262,000
61	12	7	79,000	79,000
62	7	4	51,000	51,000
63	4	2	51,500	51,500
64	4	2	51,500	51,500
65	3	2	39,500	39,500
66	5	3	include #67 157,000	157,000
67	2	1	combine with #66	
Net 63 Sites	Net 1183 acres	738 mil. gal.	$10,104,000	$7,163,900



CROSS-SECTION OF AQUIFER IN VICINITY OF LAKE MERCED

ATTACHMENT 8